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Adoption of conservation agricultural practices: The case of Dangila District, Amhara Region, Ethiopia

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Conservation agriculture (CA) is a set of practices, such as conservation tillage, soil cover and crop rotation, which increases productivity while conserving soil. Despite adoption of CA is a golden opportunity to reduce and recover aggravated soil erosion, nutrient depletion and maximize crop produce, its by farmers in Dangila district hindered because of many pessimistic perception by farmers. This study, therefore, assessed factors that affect adoption decision behavior of farmers' to CA and its implication on soil health and crop productivity in Dangila district. Multistage sampling procedure was used to identify kebeles and sample respondents. Descriptive statistics were used to summarize the data while multinomial logit model were used to identify the most important factors that determine adoption decision of CA practices. Results of from multinomial logit indicated that age of household head, educational status, distance from the plot, soil fertility status, total livestock owned and participation in kebele administration had significant influence on farmers' adoption of CA practices. Generally, the results of this study indicated that adoption of CA is the cumulative of many factors, which should be given due attention in the innovation and transfer of agricultural technologies like conservation agriculture implementation at grass root level.

Key words: Conservation agriculture, Adoption, Multi-stage, Multinomial logit model

INTRODUCTION

Agriculture occupies a key position for the Ethiopian economy, which contributes within a single year 85% of employment of the country's population, 95% of land under cultivation and contributes more than 96% total agricultural output. However, the traditional land use system hurts this sector and invites excessive soil erosion by wind and water (runoff) and consequently there is a loss of soil productivity (MOA 2011). Substantial farmers through the country face many risks due to soil erosion, water shortage, erratic rainfall, low crop productivity, food insecurity, substantial forest and surrounding environment depletion. The risks come about because of inappropriate farm practices manifested by frequently growing cereal crops without using crop rotation, long-term tillage, and less planting of cover crops. In Ethiopia the average annual rate of soil loss is estimated to be 12 t/ha/year and it can be even higher on highly inclined terrain and on places where the vegetation cover is low (Birhanu 1998). The yield reduction as a result of loss of topsoil each year is increasing to a large extent.

Use of conservation agriculture (CA) could be seen as a

potential option for Ethiopia which rely mainly and agriculture seem prime sector that could help in maintaining and improving crop yield, attaining more resilient farming system with reduced risks and hazards, while protecting and stimulating the biological function of the soil. Conservation Agriculture has ample benefit like safeguarding the environment, improving agricultural productivity, and saving labor and time (Giller et al 2009; Kassie et al 2009; FAO 2011; MOA 2011). Moreover, CA is applicable to all crops including annual crops, horticultural crops and tradable crops. It is a holistic approach to farming and includes integrated pest management system (IPMS). Empirical works (Hobbs 2007; Gowing and Palmer 2008; and Kassam et al 2010) indicate that to reverse this trend and to go in the direction fulfill the needed requirement, adopting and adapting more resilient, intensified and sustainable agricultural production systems is a priority action. The research findings indicated in (Hobbs 2007) strongly support adoption and implementation of CA practices should be taken as remedy for soil erosion.

Although many scientists advocate adoption of CA as a measure for problems brought in conventional farming operation and extensive farm inputs application focus on business as usual (aimed only maximizing production). This technology has been limitedly adopted in some areas (Derpsch 2003; Ndawa 2004). Small farmers; however, may fail to fully accept suggested agricultural technology packages, such as conservation agriculture (CA) core practices due to many factors, including resource and information constraints (Tsegaye et al 2008). Recent findings also indicate that introduced technology package are disseminated as blanket for all areas without considering agro ecology and farmers participation but should be smart, flexible and adaptable to local conditions (Moti et al 2012). Furthermore, there were impediments arise from different stakeholders linkage, including farmers work with weak cooperation and consideration of local situation introduction of new technology that aggravates the problem instead of minimizing and / or keeping the problem at least in the existing level as (Isaac et al 2009; Oreszczyn et al 2010). Moreover, transforming agriculture and expanding eco friendly agricultural practices is a precondition for sustained economic growth. In Ethiopia, population is increasing at alarming rate; farm size had shrunk from 2 ha to less than one ha in recent years. Adoption of agricultural technologies and innovations gain due attention because of it is assumed to provide increase productivity to assure food security, in line with MDGs and GTP of the country. However, empirical works indicate that most of adoption studies to date conducted in the country broadly focused on adoption of improved crop varieties, highbred cattle and modern beehives, soil and water conservation measures in both arid and watershed areas, and crop protection. The attention given for adoption of CA practices up to now is very low; however, conservation agriculture practices are known as well-suited to soil health, integrated pest management and better crop produce (CIMMYT, 1993).

In highly soil depleted areas like Dangila district, access of adequate land for crop and livestock production is very difficult. This enforces farmers perform dominantly nonstop cropping, free and over communal land grazing, low crop productivity, competing use of crop residues (burning, mulching and collecting for feed), similar to other highlands of northern Ethiopia. This may inhibit adoption of CA (minimum tillage, crop rotation and soil cover) at instant. Cognizant of the potential factors that affect adoption of CA may deserves advocacy for stakeholders specially the lion-share, smallholder farming households involve in this sector in Dangila district. Since this study is the prototype in this district may notice the reasons why farmers delayed from fully adoption of conservation agriculture practices. This study will be important for the Agricultural office of Dangila district, provide information and good opportunities to extend to other areas having the same agro ecological and some other characteristics with slight modification. This study will generate valuable information on determinants of adoption of CA and provide notice for the need to bring on deck various stakeholders including farmers, farmer organizations, government and its agents, NGOs, and the private sector in Dangila district.

Research Design

Dangila is one of the seven districts in Awi zone with an area 772.3 square kilometer. It is known to be the fourth largest in the zone with respect to its area coverage. Its border linked in East with Mecha district (West Gojjam), in West direction with Jawi district, south with Fageta Lekoma (Adis kidam) district and to the Northeast direction with Achefer district (West Gojjam). The capital city of Dangila district is Dangila town and located 38 kms from Awi zone1 town Enjebara, 78kms from Amhara region city Bahir Dar and 475kms to the Northwest from Addis Ababa, the capital city of Ethiopia. The district has 27 rural kebele2 administrative and six-urban kebele administrative. The district has largely Orthodox Tewahedo Christian believers' residential area and small numbers of Muslim followers live since its establishment after 1928 Italian invasion still now. The study was conducted in two rural kebeles called Demisa and Wufta-Datie. They have in sum comprises a total population of 7883. Based on 2007 population and house census and 2009/10 ANRS sample survey report projection results, about 190,943 people was expected to live in Dangila district . Among those, 94,160 were predicted to be male (49.3%) and 96,783 (50.7%) to be female. In addition, the prediction results indicated that, 155,466 (81.4%) people expected to live in rural areas and the remaining 35,477

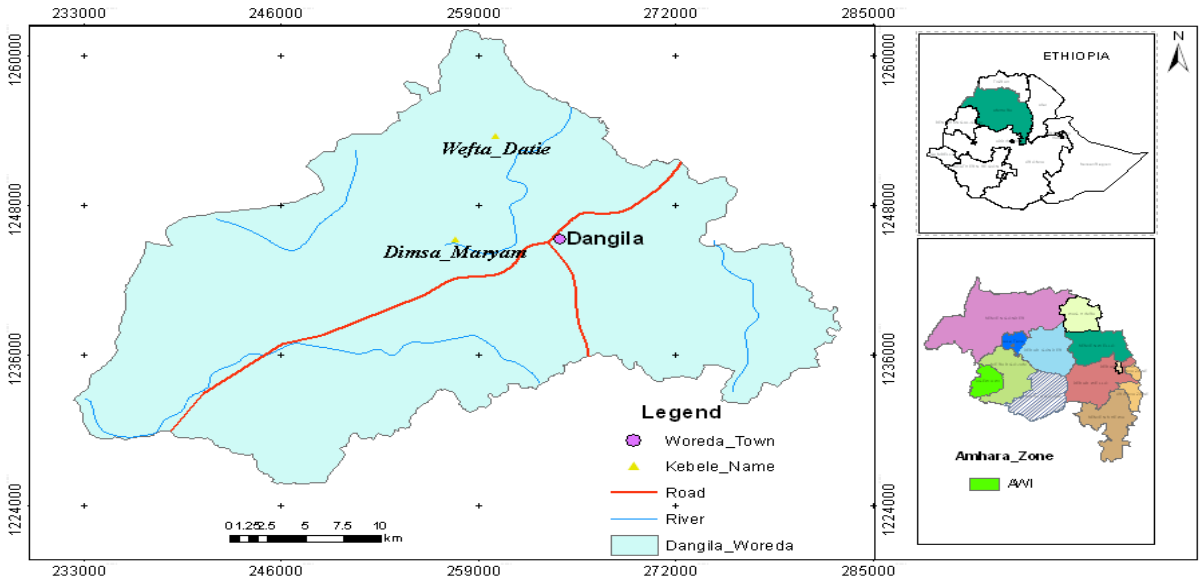

Figure 2: Map of study area Source: Adopted and modified from EMA (1987)

(18.6%) people in towns. The population density of the district is about 247.3 people per kilometer.

The economically active population (15-64) years of age accounts 51.8% of the total population. In terms of traditional agro ecology classification, the district can be categorized mainly into two Agro ecological zones; Woina Dega (middle altitude), which mask large about 86 percent of the total land mass, and 22 rural kebeles and all urban kebeles, and the Kola (low altitude), which covers about 14 percent of the total land mass and 5 rural kebeles. The district annual rainfall ranges from700-1200mms and annual temperatures ranges from 16-35 0c as the information obtain refers (CSA, 2007). The type and texture of the soil varies to a great extent. Those kebeles that are located at low to mid-altitude mostly have heavy red to brown soil. On the other hand, lowland kebeles have gray, red whitish and black soil. The farming system in the Dangila district is characterized by mixed farming. The agro-climatic condition of the district conducive for teff, maize, millet, potato, linseed, Niger seed (Nug), chick pea, pea, bean, wheat and barley are the dominant crops frequently grown in the district. Production is undertaken mainly by waiting the rainy season that is once per year. Livestock play a significant role in the mixed farming system of the area. Their main contribution is in providing draft power, guarantee, cash generation, food (example milk), and as a wealth status (symbol).

Kebele 2, According to the current Ethiopian government kebele is the smallest administrative unit, since 1991.

Zone1, it also the higher administrative unit from kebele and district (Woreda).

Both qualitative and quantitative data were collected to hit the stated objectives from primary and secondary data sources. Rich Primary data was collected from focus group discussion, transect, key informant interview, and from survey by using structured interview schedules. The nature of primary data collection was both informal observation and onsite picture taking about biophysical structures and formal interviewing the respondent (off-site and onsite). Rich primary data set was collected from sample households information on household; personal information, land characteristics, institutional factors, and socio-economic factors. Secondary data was reviewed and collected from Dangila district Agriculture and Rural Development Office, Amhara Regional Bureau of Agriculture and Rural Development, MOA, Relevant GO's and NGO's, both documentation and internet as well as other pertinent documents. A multi-stage sampling techniques were used by a researcher. In the first stage, purposive sampling was utilized to select Dangila district because of the presence of CA practice and researcher's preference. In the Second stage, from this district among 27 rural kebeles stratified based on agro ecology then two kebeles', identified as Demisa and Wufta-Datie rural kebele administrative were randomly selected. Finally, 120 sample household heads' were selected by use of random sampling technique; from the two kebeles according to proportion to size. Here, the size of sample was limited to 120 due to time, finance, and other logistic limitations.

Method of Data Analysis

The researcher for data analysis of this study was used both descriptive statistics (frequency, percentage, mean,

standard deviation, t-test, and x2-test) and a multinomial logit model. A multinomial logit model was used to predict factors that determine adoption of CA components and to identify key variables affecting farmers' decisions to invest in this practice with the support of Stata computer program version 11.0 was analyzed.

A Multinomial Logit Model

There is no inherently ordering in the decision process of adoption of conservation agriculture practices. In such situations unordered choice models can be motivated by a random utility model (Greene 1993). Hence, a choice has to make between multinomial probit and logit models. A multinomial probit model is less restrictive than the multinomial logit model. However, the multinomial probit model gained at considerable computational expenses. Therefore, a multinomial logit model is used for studying farmers' adoption status of CA components. Following (Hosmer and Lemshew 1989; and Greene 2003), the multinomial logit was used to determine factors affecting farmers' adoption decision among CA components.
The model is specified as follows:
P(Y=j) =
Where Y =0 Non-adopters of CA components
Y=1 Partial-adopters of CA components
Y=2 Adopters of CA components
The estimated equations provide a set of probabilities for the j+1 a decision to make accept alternatives. Before proceeding, we obliged to remove indeterminacy in the model. If we define for any vector q, then the identical set of probabilities result because the terms involving q will drop out. A convenient normalization that solves the problem is to assume that =0(Greene, 2003). Therefore, the probabilities are
Prob(Y=j) = ; Prob(Y=0) =
Before computing the models, it would be necessary to check whether there is multicollinearity among the candidate variables and verify the degree of association among discrete variables. According to (Gujarati 2003), there are various indicators of multicollinearity problem. Of various indicators of multicollinearity, the variance inflation factor (VIF) is used in this study to check whether there is multicollinearity or not among continuous explanatory variables and Contingency Coefficient (CC) among discrete variables were checked.

Outcome and Hypothesized Explanatory Variables

Dependent variable: It represents the observable decision of farmers to adopt, partially-adopt and not-adopt CA a practice is dichotomous or categorical variable. This outcome variable will be analyzed by multinomial logit model that will take the value 2 for adopter, 1for partially-adopter, and 0 for non-adopter. It is hypothesized as farmers used CA in the last 2 years and had practice the two or more components of conservation agriculture in combination with fertilizer and compost use considered as adopter and take the value (Y=2), had been practicing in the last 2 years' experience only I CA components in one of his/her plots considered as partially-adopter and take the value (Y=1), and a farmer not totally used will considered as non-adopter and take value (Y=0).

Independent variable: It was hypothesized as farmer's decision to adopt or reject conservation agriculture practices to gain its profit will highly influenced by different factors. Employing various related empirical studies, and qualitative data were collected from survey; Based on the previous findings and the research objectives in the study area, the following 15 potential variables were hypothesized as determinants of the adoption of CAPs.

Table1: Definition and units of measurement of the explanatory variables

RESULTS AND DISCUSSION

This part is mainly concerned with the description and interpretation of the findings. As already noted, the main aim of this study was assessing determinants of farmers' adoption of CAPs with local conditions in the study area. In this section the results of both descriptive statistics and econometric models for adoption decision of farmers are discussed in detail.

Household Characteristics

Gender and Educational status of Household Heads

Gender of household head can influence adoption of new technology either being female headed or male headed. Male headed households have better chance for adoption because of the position they have and access of information as compared to their counter parts in the study area. Out of total sample respondents, female-headed accounted for only 15.8%, while the rest 84.2% were male headed, respectively. Among female-headed respondents 42.1%, 52.6% and 5.3% were non-adopters, partially-adopters and adopters of CA practices, respectively (Table 2). Accordingly, from total sample respondents 30.8% were non-adopters, 50% were partially-adopters and 19.2% were adopters of conservation agriculture components.

As education status of household head increases, it is considered to increase the transfer of relevant information, awareness and mutual understanding about new idea, technology and innovation and as a results increase farmers' knowledge about the benefits, constraints and opportunities gain from implementing CA. Education provides something for farmers to arrest loss

Table 1: Definition and units of measurement of the explanatory variables

Variables	Variable	Expected sign	Definition and units of measurement
SEXHH	Dummy	-ve/+ve	Sex of household head (1=female , 2=male)
AGE	Continuous	-ve/+ve	Age of household head in years
EDULEVEL	Discrete	-ve/+ve	Educational level of household head (0=illiterate, 1=read & write, 2=grade 5-8th ,3=grade 9-10, and 4=above grade 10th)
PARTADMIN	Dummy	+ve	Respondents participation in kebele (0=no, 1=yes)
DISTPLOT	Continuous	+ve/-ve	Distance from resident to the plot(in minute)
FARMEXP	Continuous	+ve	Respondent's farming experience in farming activities(in years)
TOTALAND	Continuous	+ve/-ve	Respondent's total land holding in hectare
SOILFERT	Discrete	+ve/-ve	Soil fertility status(1= fertile,2= less fertile, and 3=non-fertile)
TLU	Continuous	+ve/-ve	Respondent's owned livestock (in tropical livestock unit)
GRAZING	Continuous	+ve	Respondent's own grazing land in hectare
TRAINING	Dummy	+ve	Training accessed and visited (0=no, 1=yes)
LABOUR	Dummy	+ve/-ve	Availability of labor (1=difficult to get, 2=easily get)
FERTILIZER	Discrete	-ve	Price of fertilizer costly (0=no, 1=yes)
FAMSIZE	Continuous	+ve/-ve	Both economically active & not , family numbers live in one roof (in number)
CULTIVATED	Discrete	+ve/-ve	Ownership of cultivated land (1=own, 2=shared, and rented 3 =other

Source: own extraction, 2015

Table 2: Frequency of gender in adoption categories

Sex characteristics	Non-Adopter		Partially-adopter		Adopter		Total	
	No	%	No	%	No	%	No	%
Female	8	42.1	10	52.6	1	5.3	19	15.8
Male	29	28.7	52	49.5	22	21.8	101	84.2
Total	37	30.8	60	50.0	23	19.2		
Educational level								
illiterate	26	41.3	30	47.6	7	11.1	63	52.5
Read and write	3	12.5	12	50.0	9	37.5	24	20.0
Grade 5-8th	5	26.3	12	63.2	2	10.5	19	15.8
Grade 9-10th	3	33.3	3	33.3	3	33.3	9	7.5
Above Grade 10th	-	-	3	60.0	2	40.0	5	4.2

Source: own survey, 2015

of soil fertility using various ways of soil fertility improving practices, productivity maximizing at the same time keeping soil health, traditional and improved soil conserving technologies. Out of total respondents 47.5% were literate and 52.5 were illiterate (Table 2). This means as sample respondents not educated it may increase the possibility of farmers' rejection of new technology and innovation and if educated more, otherwise is true.

Age of sample household heads

The mean and standard deviation age of sample respondents were 43.7 and 10.9, respectively. The age composition of sample respondents were revealed significant difference of the adopters, partially-adopters and non-adopters 41.7, 42.2 and 51.3 mean of years, respectively. The maximum age observed was 74 and the minimum was 20 years (Table 3). Increase age of farmers already engaged in farming operation, it gives

Table 3: Distribution of sample household heads by age

Age of household head in years	Non-adopters		Partially-adopters		Adopters		Total	
	No	%	No	%	No	%	No	%
18-40	19	15.8	26	21.7	3	2.50	48	10.9
41-65	18	15.0	33	27.5	17	14.2	68	56.7
>65	1	0.83	1	0.83	3	2.50	5	4.17
Mean	41.7		42.2		51.1		43.7	
	Min 20	Max 74						

Source: own survey, 2015

Table 4: Frequency distribution of family size of sample households

Family size	Non-adopters		Partially adopters		Adopters		Total	
	Number	Percent	Number	Percent	number	Percent	number	Percent
≤2	1	0.83	2	1.67	-	-	3	2.50
3-5	15	12.5	20	16.7	7	5.83	42	35.0
6-10	21	17.5	38	31.7	14	11.7	73	60.8
>10	-	-	-	-	2	1.67	2	1.67
Mean	6.08		6.03		6.61		6.61	
	Min 2	Max 11	Total family size of Demisa =256, Wufta-Datie=483					

Source: own survey, 2015

time for farmers to learning from directly observed and evaluate problems and profits of the crop produce. As the mean of age revealed that adopters are relatively older than partially-adopters and non-adopters of CA.

Distribution of sample households by family size

The total family sizes of sample household were found to be 256 and 483 in Demisa and Wufta-Datie kebeles, respectively. In the study area, household head with family size of less than or equal to 2 members constitutes 2.50%; 3 to 5 members constitute 35%; 6 to 10 members constitute 60.8 % and 11 and above members constitutes 1.67 % (Table 4). The average family sizes for adopters were found to be 6.61, for partially-adopters were 6.03 and that of non-adopters were 6.08. This is slightly above national average number children of one woman delivery between 15-49 ages 5.1 children. The maximum and the minimum household size of the sample respondents were found 11 and 2. About 17.5% of the household heads of non-adopters, 31.7% of partially-adopters and 13.3% of adopters had above 6 numbers of family members. The economical active family members are inputs and advantageous for farm worker and otherwise is burden and have negatively influence for farm technology adopters. To illustrate this the one household who has more economical inactive family members, the household head always enforced to cultivate the same crop from season to season and year to year in order to close family members mouth. In contrary, economically active family members are assumed as labour. Thus, family members have indeterminate influence on adoption of CA in the study area.

Socio-economic Factors

Land Characteristics

The land size holding of the sample farmers ranges from 0 to 3 hectares. The average land holding is known to be 1.95 hectares with a standard deviation of 1.52 hectares. This is slight greater than national average 1.5 hectare of land. The survey result indicated that about 13.3% of the respondents had a farm size of 0.5 hectare or less, 31.7% of respondents had a farm size ranges 0.51-1.5 hectares and the rest 55% of respondents had farm size of greater than 1.5 hectares of land. On the average adopters hold more land 2.32 hectare; partially-adopters hold 1.81 hectare and non-adopters 1.94 hectare of land, respectively (Table 5). This illustrates as household own more unit of land, the household inspired to make decision to adopt like CA.

Ownership of cultivated land

According to Table 6 results revealed that 28.3% were cultivate own plot, 25% were cultivated on basis of sharecropped and rented, 42.5% were cultivate both own and sharecropped and rented land and the remaining 4.17% were cultivate land on other ways (inherit, gift from

Table 5: Distribution of land holding size with adoption categories

Farm size in hectare	Non-adopters		Partially-adopters		Adopters		Total (N=120)	
	Number	%	Number	%	Number	%	Number	%
≤0.5	5	4.17	11	9.17	-		16	13.3
0.51-1.50	17	4.2	17	14.2	4	3.3	38	31.7
>1.50	15	12.5	32	26.7	19	15.8	66	55.0
Mean	1.94		1.81		2.32		1.95	
Min = 0	Max = 3						SD 1.52	

Source: own survey, 2015

Table 6: Association between ownership of cultivated land and adoption

Ownership of Cultivated land	Y=0		Y=1		Y=2		Total		X^2-value
	N	%	N	%	N	%	N	%	
Own	11	32.4	11	32.4	12	35.3	34	28.3	11.627*
Sharecropped & rented	11	36.7	17	56.7	2	6.7	30	25.0	
Both	13	25.5	30	58.9	8	15.7	51	42.5	
Other	2	40.0	2	40.0	1	20.0	5	4.17	

* Significant at 10% probability level
Source: own survey, 2015

family and youth arrangement). Out of the total sample respondents cultivated their own land 32.4% were non-adopters, 32.3% were partially-adopters, and 35.3% were adopters of CA components.

As the chi-square result indicated that (11.627) there is significant and positive relationship between households own more unit of land and adoption other than sharecropped and rented mechanisms of cultivated of land at 10% probability level. This means farmer's perception for his/her land is give more value than other forms, this is the synergy that push farmers to accept new idea and technology and implement in way to assure simultaneously more produce and to inherent fertile soil for his/her children. In the study area, farmers' perception to new technology can be seen with knowledge and understanding of soil fertility status, especially they compare with crop produce either increases or decreases. Farmers perceive and rated soil fertility of their land as fertile, less fertile and not fertile in the study area. The reason for farmers reach such decision on soil fertility depletion with the amount of fertilizer they use, compost and other organic matter adding nutrient application and the type of crop grown and yield obtain.

In other words, this informs for farmers' to adjust their perception towards adoption of CA will increase as the soil fertility level decreases one category. In order to understand perceptions of farmers about land ownership right and to investigate whether private property right has an effect on soil erosion, management of land and technology adoption or not, different questions were posed to the sample respondents. Those farmers feel land ownership as government discourage to plant trees and cover crops, leave crop residues and use soil improving technologies; CA practices in aggregate in the study area. As the Table 9 below, revealed that 10.8% thought as own and 89.2% were thought as the government. Even if less percent of adopters replied ownership land is to myself have positive influence for adoption of CA. On the other hand, farmer's perception on land ownership is not changed although the current government tries to answer the land tenure issue with offer land tenure certification.

Farmer's perception on land tenure is mostly distorted to one direction since government is the merely owner and the farmer has the right to use and cultivate. Following government substitution land re-distribution was done in 1997 in the study area. This put its impression and vivid influence on farmer's use of land with updated technologies and management of land with feeling of self. Despite to this, farmers feelings of land ownership is still not changed due to they have floated and pending questions although the government trying to answer to a degree by offering land tenure certification not jump to the right to use and cultivate his/her plot. The results of chi-square indicated that (7.057) ownership of land has significant affirmative relationship with adopters for those farmers perceive as to own at 5% probability level.

As Farmers explained during observation and discussions held as the one farmer who cultivate land in the form of sharecropping and renting is totally different in time of cultivation of own land. This is due to farmers fear increase loss of fertilizer and seed cost if crop is

Table 7: Association between farmers' perception to land ownership and adoption

Ownership of land	Non-adopters		Partially-adopters		Adopters		Total		X^2-value
	N	%	N	%	N	%	N	%	
To myself	2	15.4	5	38.5	6	46.2	13	10.8	7.057**
government	35	32.7	55	51.4	17	15.9	107	89.2	

** Significant at 5% probability
Source: own survey, 2015

Table 8: Respondents' opinion for land tenure right

Opinion on land utilization Inherit to family	Non-adopters		Partially-adopters		Adopters		Total		X^2-value
	No	%	No	%	No	%	No	%	
	31	33.3	44	47.3	18	19.4	93	77.5	
Fully utilize	31	29.0	55	51.4	21	19.6	107	89.2	
Land tenure									
have effect	14	29.8	23	28.9	10	21.3	47	39.2	0.224^{ns}
have not effect	23	31.5	37	50.7	13	17.8	73	60.8	

ns= not significant at any (1%, 5% and 10%) probability level
Source: own survey, 2015

disappeared by any means at the time of both sharecropping and renting. The other reason for poor management of rented and sharecropped land is due to the soften and well prepared land may be taken by the owner of land provider for sharecropping and renting as his/her want, no guarantee. The sharecropping and renting of land depends on sharecropper's own number of oxen, recognition in plowing in the local, soil fertility and distance basis. Accordingly, 60.8% were replied as land tenure have an effect on overall land use and management and 39.2 % were replied as otherwise, respectively. However, the result of chi-square indicated that (0.224) there is no relationship between land tenure and adoption of CA components at all 1%, 5% and 10% probability level.

On the other hand, 77.5% of sample respondents in both kebeles replied that they had interest to inherit their land to their families at the time of death, of which 33.3% were non-adopters, 47.3% were partially-adopters and 19.4% were adopters. Furthermore, besides farmers' perception on land ownership, tenure right and inheritance mechanisms, 89.2% of respondents had interest to use land fully throughout their life. Among these farmers showed their interest on fully utilization of land in their life time; 29% were non-adopters, 51.4 % were partially-adopters and 19.6% were adopters of CA.

Farmers' perception on soil fertility

Traditionally, farmers have been practicing soil fertility improving and organic matter increasing, enhance water holding capacity and boost crop produce in the study area. These includes, use of compost and animal dung, fallowing, crop rotation, plantation of cover crops, mixed cropping and intercropping as a means of dual purpose modifying soil fertility loss and low crop productivity. Farmers' perception depends on the knowledge they have and from observations and evaluation of neighbor farmers benefit gain from adoption of new ideas, technology and innovations. Farmers perception for CA can be determine by Age, educational status, farming experience, wealth status, land size, understanding of level of soil fertility and methods they use to solve the problem.

Out of total sample respondents, 70.8% reported as decrease and 29.2% were reported as had no change still in soil fertility in survey year 2015. Among sample respondents observed soil fertility decrement asked to rank the severity level, of which 61.2% said high, 35.3% said medium and 3.53% said as become low. The percent describes how much farmer's perception and understanding to soil degradation is go one pace for change and they may come to on adoption of soil improving technology. Understanding of the perception of farmers about trend of crop productivity and their reasons for yield reduction or not, gives insight to do on adoption of locally in situ technology options like CA. As the response obtain from sample respondents indicated that productivity of crops not increase while we use fertilizer as recommended and improve varieties of crops although in the year 2003/2004 reaches maize productivity maximum, like green revolution was in India .

Table 9: Farmers' perception for soil fertility level

Soil Fertility Trend	Number	Percent	Severity of soil fertility loss	Number	Percent
Decrease	85	70.8	High	52	61.2
Remained the same	35	29.2	Medium	30	35.3
			Low	3	3.53

Source: own survey, 2015

Table 10: Mean differences of continuous variables

Continuous variable	Non-adopters	Partially/adopters	Total		T-value
	Mean	Mean	Mean	SD	
AGE(in years)	47.7	44.7	43.7	10.9	-1.408**
FAMSIZE	6.08	6.19	6.17	1.99	-0.282
FARMEXP	21.1	21.8	21.7	9.52	-0.324
TOTALAND(ha)	1.58	1.95	1.83	0.93	-2.034**
TLU	7.39	8.90	8.43	4.46	-1.727**
DISTPLOT	38.9	27.5	31.0	24.8	2.394***
MAINMARK	149.2	151.3	150.7	27.7	-0.388

*** Significant at 1% probability level and ** Significant at 5% probability level

Summary of Results of Descriptive Statistics

The mean values of the continuous variables in both non-adopter and partially-adopter/adopter groups were compared using t-test. The test is used to indicate the mean differences between groups. That is why the test was used to identify the mean difference between non-adopter and partially-adopter/adopter respondents. The t-values of 7 continuous variables were computed and out of these variables the two groups were found to be different significantly in 4 of them.

Accordingly, the mean differences of the variables of age of the household head (AGE), household total land holding (TOTALAND) and total tropical livestock unit (TLU) were significant at 5% probability level where as the distance between farmers resident to the plot (DISTPLOT) was significant at 1% probability level. In this respect, a chi-square test was used to examine the existence of statistically significant relationships between the three groups. Accordingly, 7 discrete variables were considered and the two groups were found to be different in terms of 3 of the 7 variables (Table 11). More specifically, the chi-square test reveals that two, one and one discrete variable showed statistically significant differences between the three groups at 1%, 5% and 10% probability level, respectively.

Econometric results of the multinomial logit model

As done various tests of multicollinearity were conducted and hence variables were found free from the problem of multicollinearity. The various goodness of fit measures were checked and validate that the model fits the data. The likelihood ratio test statistics exceeds the Chi-square critical value at less than 1% probability level. This implies that the hypothesis, which says all coefficients except the intercept is zero, was rejected. The value of Pearson Chi-square test shows the overall goodness of fit of the model at less than 1% probability level.

As can be seen from Table 12, of all the 15 explanatory variables considered as determinants for the adoption decision of sample households among components of CA technology, 1 and 2 variables were found to have significant impact on the decision to accept CA for non-adopter and adopter groups, respectively at (P< 0.01). 2 variable for the adopter and 3 variables for the non-adopter of CA practices were significant at (P< 0.05) to encourage the decision of non-adopters to be found rigid. The effect of some significant variables is not similar for the two categories. Some may be highly significant to affect the choice decision for a particular category and may be insignificant for the other category.

Interpretation of Empirical results

Age of the household heads (AGE): This variable is highly significant at (P<0.01) to affect decision of adopter farmers but insignificant for non-adopters of CA practices and technologies. This variable has positive sign of the coefficients in adopters' but negative sign of the coefficients non-adopters of CA practices exactly match

Table 11: Correlation of discrete variables via adoption category

Variables		Non-adopters		Partially adopters		Adopters		Total		X^2-value
		N	%	N	%	N	%	N	%	
SEXHH	1	8	42.1	10	52.6	1	5.26	19	15.8	3.238
	2	29	28.7	50	49.5	22	21.8	101	84.2	
EDULEVEL	0	26	41.3	30	47.6	7	11.1	63	52.5	
	1	3	12.5	12	50.0	9	37.5	24	20.0	
	2	5	26.3	12	63.2	2	10.5	19	15.8	17.013**
	3	3	33.3	3	33.3	3	33.3	9	7.50	
	4	0	0.00	3	60.0	2	40.0	5	4.17	
CULTIVATED	1	11	32.4	11	32.4	12	35.3	34	28.3	
	2	11	36.7	17	56.7	2	6.67	30	25.0	11.627*
	3	13	25.5	30	58.8	8	15.7	51	42.5	
	4	2	40.0	2	40.0	1	20.0	5	4.17	
SOILFERT	1	9	42.9	9	42.9	3	14.3	21	17.5	
	2	27	30.7	44	50.0	17	19.3	88	73.3	3.934
	3	1	9.09	7	63.6	3	27.3	11	9.17	
PARTADMIN	0	26	55.3	17	36.2	4	8.51	47	39.2	22.56***
	1	11	15.1	43	58.9	19	26.0	73	60.8	
GRAZING	0	15	29.4	29	56.9	7	13.7	51	42.5	2.264
	1	22	31.9	31	44.9	16	23.2	69	57.5	
LABOUR	0	7	41.2	7	41.2	3	17.7	17	14.2	1.019
	1	30	29.1	53	51.5	20	19.4	103	85.8	
TRAINING	0	15	53.6	11	39.3	2	7.14	28	23.3	9.717***
	1	22	23.9	49	53.3	21	22.8	92	76.7	
FERTILIZER	0	3	30.0	4	40.0	3	30.0	10	8.33	0.889
	1	34	30.9	56	50.9	20	18.2	110	91.7	

*** Significant at1% probability level, ** Significant at 5%, and *Significant at 10% probability level
Source: Own survey, 2015

with the idea in the hypothesis. This means that farmers who have more age will have adequate know how their farming and solutions and motivated to adopt conservation practices in their plot. Despite to the earlier, farmers' with less and no longer live means of age have no sound perception and retreat from adoption of new ideas and technology of CA. The odds ratio 1.230 in adopters group indicates that with decision in favor of preference of CA assuming partially-adopters constant, as age increases the adopter of CA likely increases by a factor of 1.230 per age level. Likewise, the decision for non-adopter group decreases by a factor of 0.974 per age level.

Distance from the plot (DISTPLOT): Distance from dwelling to the plot is significant at (P<0.01) and (P<0.05) considered to affect the decision of both adopters and non-adopters assuming partially-adopters category constant. The parameters took the expected sign, which is negative in adopters but positive in non-adopters. The result is consistent with the idea of the hypothesis. The negative sign of the coefficients was as anticipated indicating that as the distance of a plot from homestead is large, farmers are not interested to adopt CA practices. Theoretically, it was true for both cases. The odds ratio 0.917 for adopter farmers indicate that keeping the influences of other factors constant, the decision to accept and implement CA for adopter farmers decrease by the rate of the above mentioned factors as distance of the plot increases by minute. Similarly, the possibility for non-adopter's likely increase by 1.024 as distance of the plot increases by one minute unit. Educational level of household head (EDULEVEL): Education level is significant to affect the decision for adopters at (P< 0.05) but insignificant for non-adopters assuming partially-adopter category is constant. The coefficients in adopter category is positive but in non-adopter category is negative are found to be match with hypothesis. The result shows that increase in the level of education of the head of the household enables him to identify and to select convenient CA components to adopt. The odds ratio 2.389 for the adopters group indicate that keeping the influences of other factors constant, the decision to adopt CA practices fully gets increasing as the education level increased by one category unit. Whereas for non-adopters decreases by a factor of 0.761 increases per one category level unit.

Table 12: Parameter estimates of the multinomial logit model

Adoption category		B	Odd	Wald	Sig.
	INTERCEPT	8.937		2.310	0.021
	SEXHH	0.422	1.525	0.540	0.587
	AGE	-0.026	0.974	0.730	0.463
	EDULEVEL	-0.273	0.761	1.000	0.317
	FAMSIZE	-0.016	0.984	0.100	0.919
	SOILFERT	-1.174	0.309	1.350	0.041**
Non-adopters	CULTIVATED	-0.428	0.651	2.050	0.717
	DISTPLOT	0.024	1.024	2.160	0.031**
	FARMEXP	0.048	1.049	1.200	0.229
	TOTALAND	-0.214	0.807	0.500	0.614
	PARTADMIN	-02.099	0.123	3.720	0.000***
	TLU	-.027	0.973	0.360	0.719
	GRAZING	0.677	1.968	1.200	0.230
	LABOUR	-0.894	0.409	1.050	0.292
	TRAINING	-1.638	0.194	2.410	0.016**
	FERTILIZER	-0.458	0.633	0.460	0.643
Partially-adopters	(Reference Group)				
	INTERCEPT	13.012		2.000	0.046
	SEXHH	1.908	6.741	1.290	0.198
	AGE	0.207	1.230	3.160	0.002 ***
	EDULEVEL	0.871	2.389	2.450	0.014**
	FAMSIZE	0.097	1.102	0.440	0.657
	SOILFERT	0.660	1.936	1.390	0.374
Adopters	CULTIVATED	-0.593	0.553	0.890	0.164
	DISTPLOT	-0.087	0.917	2.760	0.006***
	FARMEXP	0.255	0.974	0.510	0.608
	TOTALAND	0.252	1.287	0.460	0.642
	PARTADMIN	1.220	3.352	1.380	0.167
	TLU	-0.191	0.826	2.030	0.042 **
	GRAZING	0.240	1.271	0.320	0.749
	LABOUR	-0.184	0.832	0.150	0.880
	TRAINING	0.627	1.873	0.580	0.562
	FERTILIZER	-1.393	0.248	1.310	0.190

*** Significant at 1% probability level Log likelihood = -76.176
** Significant at 5% probability level, and;
*Significant at 10% probability level

Soil fertility status of plot (SOILFERT): Soil fertility of the plot is highly significant at (P<0.05) the decision for non-adopter but insignificant to affect the decision and put into ground CA for adopter category. The coefficients of this variable are positive for adopters but negative for non-adopters. This result is consistent with the idea in the hypothesis. This means that as the soil become less fertile farmers are motivated and eager to accept and test new technology on their plot and otherwise. The odds ratio 0.309 in the non-adopter indicate that assume the influence of partially-adopters are factors constant, the decision and accept of CA likely decreases by 0.309 as the soil fertility decreases. In contrary to the above, the decision and accept to CA in the adopters will likely increase by 1.936 as the soil fertility level decreases. Total Tropical Livestock Unit (TLU): Total tropical livestock is significant at (P<0.05) affect the decision and implementation of conservation practices for adopters but insignificant for non-adopters keeping the influence of partially-adopters group constant. The sign of coefficient for adopters is negative but positive for non-adopters that match with the hypothesis. Therefore, as household has more livestock hardly affected to adopter and affirmatively affected to be found non-adopters as compared to partially adopters of CA. This is theoretically true. The odds ratio 0.826 for adopters indicates that the decision for farmers to adopt CA will decrease by 0.826 as the household own one more tropical livestock unit. Despite to this, for non-adopters group likely increase by 0.973 as livestock increases by one more units.

Participation in Kebele administration (PARTADMIN): participation in kebeles administration or village and social

issues is significant highly at (P<0.01) to affect the decision to reject CA for non-adopters but insignificantly affect adopters group. The coefficients are as expected, which is positive for adopter but negative for non-adopter as theory supports. This means that farmers who have position or participation in kebele administration are positively influenced to be found adopter, whereas as farmers engaged in kebele administration and takes social responsibility to be found non-adopter could be left. The odds ratio 0.123, in the non-adopter group indicate that consider the influence of other factors constant, the decision of farmer to reject CA increases by a factor of 0.123 as farmers not involve in kebele administration and takes less or no social responsibility. In similar fashion, the decision to accept and implement CA for adopters close by 3.352 as farmers takes responsibility in society and involve in kebele administration. Training access (TRAINING): This variable is significant at (P<0.05) affect the decision of non-adopters but insignificant for adopters keeping constant the influence of partially-adopters group. The sign coefficient is positive for adopter but negative for non-adopter. The sign of coefficients is agreed with the hypothesis and with the theoretical framework. The odds ratio 0.194 in the non-adopters group indicate that leaving the influences of other factors aside, the decision to reject CA for non-adopters decrease as training and extension services access decrease 0.194 per access. Correspondingly, the decision and acceptance of CA for adopters' increases by a factor of 1.873 per unit of access with training and extension service access.

CONCLUSIONS AND RECOMMENDATIONS

Despite Agriculture is the leading sector, in the Ethiopian economy, was and still is characterized by low productivity in general and low yield per unit area in particular. Many people attribute the problem with population explosion, immense environmental degradation, limited accessibility and use of technology, insufficient infrastructure, poor traditional practices and ill-thought-out polices. This outdated and tied with bottlenecks, agricultural sector manifested by coupled with population growth at a faster rate, soil fertility depletion and decrease of crop yield, motivate to adopt conservation agriculture (CA) practices, which is agricultural-environmental management system will be taken as a panacea for short-term and long-term policy design. This study has attempted to look personal, socio-economic, biophysical and institutional and other related factors, which can affect adoption and continuously use of CA technology.

Fifteen variables were hypothesized to determine farmers' adoption of CA practices and their decision to keep it. Evidences from descriptive analysis indicated that adopter farmers have more age, better educational status, less fertile soil, own greater size of land, minimum distance between the residence and plot, cultivated own land instead of sharecropped and rented, participated in kebele or village administration and takes social responsibility and better accessed extension services in the form of field visit, demonstrations, farm training on sustainable land management specifically SWC and CA practices. On the other hand, non-adopter and partially-adopter farmers were highly negatively affected by those cited variables. The results of multinomial logit model analysis indicated that three variables at (p<0.01) and five variables at (p<0.05) were found to significantly affect adoption CA.

Generally, it is not worthy adopters, partially-adopters as well as non-adopters have unconcern perceptions on the positive and negative aspects of conservation agriculture, but other factor may more influence on farmers' adoption decision. This suggesting that other unspoken factors such as income, subsidy, and immediate benefits might explain observed difference in adoption. Further research on win-win approach relative to implementation of conservation agriculture by small holder farmers in short-term and long-term over conventional farming, locally flexible and adaptable, changes in yield, selective and appropriate for the type of agro ecology and soil type, environmentally healthy, and preferred with existing costs of inputs is advisable.

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